One Goal: ***To Prevent Cancer Incidences in Women through the Promotion of Physical Activity***

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Introduction

Studies show that an increase in physical activity has the power to decrease one's risk in developing specific types of cancer. There is significant evidence that physical activity reduces the risk of breast, colon, and endometrial cancer. According to the "State of the Epidemiological Evidence on Physical Activity and Cancer Prevention," 24% of endometrial, 20% of breast, and 19% of colon cancer cases among women could theoretically be prevented if physical activity levels were adequate (2). Research shows that women have the ability to reduce their risk for breast cancer by 20-80%, for colon cancer by 30-40%, and for endometrial cancer by 20-40% by engaging in adequate levels of physical activity (4,5,8). These cancers were specifically identified for study due to their inverse relationship to physical activity and familial genetic link.

Eligibility for this study was based on research that indicates 5-10% of all cancer cases are hereditary (3). A family history component has been linked to breast cancer for many years. A meta-analysis of seventy-four published articles found breast cancer's relationship to first and second-degree relatives is statistically significant (12). According to "A prospective study of family history and the risk of colorectal cancer," a family history of colorectal, or colon, cancer is also associated with an increased risk of disease (13). Having a family history of endometrial cancer has also been found to be a risk factor in having endometrial cancer (14).

Research has shown that brief programming interventions have the power to change subjects' attitude towards a behavior and intent to change a behavior. Previously, we have found that the addition of technology, personalized feedback, and support through counseling (Body Awareness Programming) is effective in increasing intent to be physically active in 6 to 17 year old boys (Lieber, 2011). Not only has intention been proven to improve through a brief intervention in young adolescent boys, but a recent study has also shown that a short intervention has the ability to significantly improve smokers' intent to stop smoking (9). The framework utilized in this study, the Theory of Planned Behavior, was recognized as a worthy model for short interventions in a recent study examining behaviors related to breakfast consumption (10).

Influencing individuals by decreasing a preventable risk factor is a powerful methodology for eliminating cancer incidences. It has been shown that education alone (i.e. giving participants facts) is not effective in promoting behavior change. However, previous research has shown that the addition of technology, personalized feedback, and support through counseling (Body Awareness Programming) is effective in increasing intent to be physically active (Lieber, 2011). These findings are the foundation upon which the current study was designed. Lieber's findings were not compared to a control group. As such, this study aimed to test Body Awareness Programming's effectiveness in increasing one's intent to be physically active and attitude towards physical activity by incorporating a control group, which received Educational Awareness Programming instead of Body Awareness Programming.

Methods

The study was reviewed and approved by Ohio State University's Institutional Review Board (IRB) and Ohio State University's Clinical Scientific Research Committee (CSRC). Data was measured and collected at Ohio State University's exercise physiology laboratories located in a top rated science museum over a four-month period. To be eligible for the study, subjects were females between the ages of 18-65 who have or had a biological family member within two generations that has or had been diagnosed with breast, colon, and/or endometrial cancer. Subjects also had to be "low risk" as determined by the Physical Activity Readiness Questionnaire. Subjects were recruited within the science museum, through advertising emails and flyers, and through Ohio State University's online recruitment tool: *Research Match*. Subjects were randomly assigned to 1 of 2 conditions. In Condition 1 (n=50), known as Body Awareness Programming, subjects received a body composition analysis as determined by a BodPod (BP), which estimates fat mass and lean mass. This is a highly technological tool that creates little subject burden and is quick, easy, and accurate. Data collected during this analysis was also used to determine participants' Body Mass Index (BMI). Subjects then partook in a MicroFit fitness test, which consisted of a variety of fitness measurements: skin fold thickness, blood pressure, resting heart rate, flexibility, strength, and aerobic capacity. Subjects received a personalized consultation, which reviewed subjects' fitness test results, the relationship of physical inactivity with specified cancer type, and received an exercise prescription.

In Condition 2 (n=50), known as Educational Awareness Programming, subjects received literature that reviewed the importance of a physically active lifestyle, the

relationship of physical inactivity with specified cancer type, and received exercise prescription suggestions. Pre- and post-test questionnaires were used to determine if personalized information through testing and counseling had a significant effect compared to the control group (literature) on attitude and/or intent to be physically active. The impact the treatment had on intent to engage in physical activity and attitude toward physical activity was measured by the previously validated instrument, the Theory of Planned Behavior Questionnaire (1,6,7) which is shown in Appendix 1. The study questionnaire consisted of nine questions. The first six questions measured subjects' instrumental and affective attitude towards exercise and the last three questions measured the subjects' intent to exercise. Subjects also completed four yes or no questions for qualitative descriptive use. Paired t-tests with Bonferroni correction were used to examine significant changes in questions from pre to post test questionnaires within Body Awareness and Educational Awareness groups. An ANOVA was used to examine change scores between Body and Educational Awareness groups for significant difference between groups.

Procedures

Body Composition: The BodPod is considered to be the "gold standard" for measuring body composition (Life Measurement Instruments, Concord, California). The BodPod was calibrated following manufacturer's instructions before each test. Subjects' height was measured using a stadiometer and was recorded to the nearest 0.5 inch; subjects' weight was measured to the nearest 0.5 pound using the BodPod system scale. Once subjects changed into BodPod standard clothing (tight fitting spandex shorts, sports bra, and swim cap) provided by the lab, subjects sat inside the pod for approximately two

minutes while body volume was measured using air displacement plethysmography (ADP). Subjects' lung volume was accounted for and predicted by BodPod software. BodPod software also calculated body density after measuring subjects' height, weight, and volume using the Siri formula ($BF = (4.95/\rho - 4.50) \times 100$) (11). Density models were chosen based upon the subject's sex, age, and ethnicity. This method of testing is highly desirable due to a decreased subject burden and high instrument reliability and validity. Body composition testing revealed subjects' lean mass, fat mass, relationship to normative data, and estimated daily caloric expenditure. All measurements were taken according to the manufacturer's instructions.

Body Mass Index (BMI): Using BodPod data, BMI percentile was calculated using Centers for Disease Control's Adult BMI Calculator. Categories of Adult BMI are in Table 1.

Fitness Assessment: The comprehensive fitness assessment was completed using the MicroFit Comprehensive Fitness Testing System. The MicroFit system is a Food and Drug Administration approved device and was used to measure subjects' blood pressure, resting heart rate, skinfold thickness, hamstring flexibility, bicep muscular strength, and aerobic capacity. Results were compared to normative data for subjects' sex and age group.

Blood Pressure and Resting Heart Rate: Blood pressure and resting heart rate were measured with an automated, medical-grade device. Subjects put cuff on upper left arm and relaxed as measurement took place. The pressure in the cuff automatically increased to 170 mmHg and then decreased at a constant rate of 3-5 mmHg per second. The system reported subjects' systolic and diastolic pressure and resting heart rate.

Skinfold Thickness: Skinfold body fat protocols were selected for *adult women*. Subjects were measured at three sites on the right side of the body: the tricep, the abdomen, and the quadricep. The Microfit FAS-2 skinfold caliper measures skinfold thickness up to 50mm with accuracy to within 0.5% or 0.1mm. Skinfold measurements are correlated to Lange caliper measurements.

Aerobic Fitness: The aerobic capacity test was completed on an electronically braked cycle ergometer: MicroFit Ergomedic 828 E. A multi-stage submaximal volume of oxygen protocol was used based upon subjects' age (18-39 years and 40-65 years). Polar heart rate monitors measured subjects' heart rate and pedal resistance was measured in watts (W). Subjects kept a steady and continuous revolution per minute (RPM) speed until they attained a sufficient submaximal heart rate. An estimation of aerobic fitness was established by the heart rate response at 85% of the subject's predicted maximum heart rate. Subjects' maximal volume of oxygen (VO_2max) score was computed based on the linear relationship recognized between heart rate and VO_2max. This relative VO_2max value described in ml/kg/min was then compared to normative data for subjects' sex and age group.

Strength Test: Participants' bicep strength was evaluated using the MicroFit FAS-2 strength scale, a static strength-testing mechanism. The subject was directed to stand on the force plate. The strap for the bicep curl attachment was re-sized so that her elbow joint was at a ninety-degree angle when pulling up on the bar; she was also instructed to hold the bar in an under-hand position. Subjects were told to use only their biceps, with no help from their shoulders, abdomen, back, or legs, and to hold a maximal pull for 3-4

seconds. The bicep strength score was then compared to normative data for participants' sex and age group.

Flexibility Test: Subjects' flexibility was evaluated using a standard sit-and-reach test via the MicroFit Flexometer SP. Subjects were told to remove their shoes, sit on the floor, and place their heels in the designated places on the Flexometer. Subjects had to keep their legs straight and flat on the ground, place one hand on top of the other, keep their palms down, and reach forward on the scale as far as they could without bending or lifting their legs. This method was repeated three times and recorded on the fourth test, when they held the stretch for four seconds. The flexibility score was then compared to normative data for subjects' sex and age group.

Counseling Session: Counseling sessions for women in Condition 1 (Body Awareness Programming) included reviewing the subject's BodPod and fitness test results in comparison to normative data, educational information regarding physical activity, educational information regarding the inverse relationship of physical inactivity and the specific cancer, and personalized exercise prescription suggestions.

Educational sessions for women in Condition 2 (Educational Awareness Programming) included educational information about physical activity, educational information regarding the inverse relationship of physical inactivity and the specific cancer, and generalized exercise prescription suggestions. Both sessions were open to participants' questions.

Data Analysis: Pre-test and post-test questionnaires determined if the assigned condition affected subjects' attitude and/or intent to be physically active. Paired t-tests with Bonferroni correction were used to examine significant changes in questions from

pre to post test questionnaires. ANOVA was used to examine change scores between groups for significance. Pearson's Chi-Square tests square tests were also performed to examine relationships that existed between groups.

Results

A total of 100 women aged 18 to 65 years participated in this study. No subjects were excluded from data analysis for failing to complete the study. Subjects' average age was 35.96 years, average height was 64.88 inches, average weight was 153.47 pounds, and average BMI score was 25.57 kg/m^2. Descriptive characteristics of all subjects are found in Table 2. Subjects' descriptive characteristics in both groups were very similar and were not statistically significant.

Results indicate a significant positive improvement ($p < .05$) for all pre to post test questionnaire scores regarding attitude and intent to be physically active for Body Awareness Programming. Change scores are shown in Table 3. Significant improvement ($p < .05$) was also seen in all Educational Awareness Programming scores with the exception of question 5. In both groups, scores for questions 7, 8, 9 measured one's intent to participate in physical activity and showed a greater increase than questions measuring one's attitude toward physical activity. Sixty to seventy percent of women in both Body and Educational Awareness groups had a higher post-test score for questions 7, 8, and 9. Descriptive and group statistics related to questionnaire scores for Body Awareness and Educational Awareness groups are found in Table 3.

No significant difference, as shown in Table 4, was found between Body Awareness and Educational Awareness groups when examining questionnaire scores.

Both programs seem to demonstrate a similar positive effect on women's attitude and intent towards physical activity.

Discussion

The results suggest that women with a family history of cancer respond in a comparable positive manner to generalized educational programming as they do to more personalized information. Many previous studies have indicated education as an ineffective methodology to promote behavior change; however, the specific population analyzed in this study was different to those that have been formerly investigated. It is quite possible that the Educational Awareness group was a more motivated population due to increased risk of cancer and personal experience with the disease. These concerned and empathetic individuals, like all others, know that "exercise is good for you," however, many did not previously know the specific information learned in the Educational Awareness session. For example, being physically active may reduce one's personal risk of breast cancer by 20% and up to 80%. This detailed piece of information is more likely to make an impact than "exercise is good for you," especially to an individual who has seen the effects of breast cancer in her own family.

Study Limitations

Study limitations include measurement bias. Many times in research with human subjects, participants are extremely reluctant to give socially "unacceptable" answers, for they are afraid of being judged by the researcher. Women in this study may have selected higher numbers on the Theory of Planned Behavior Questionnaire to reflect a more positive attitude towards physical activity and a higher intention to participate in physical activity than they actually felt. Many women answered the pre-test

questionnaire with very high scores in both groups, thus women in both groups may have felt compelled to "impress" the researcher with their positive attitude and intention to exercise.

Another study limitation may have been the questionnaire instrument used. The Theory of Planned Behavior Questionnaire has been a validated tool; however it may not have been the best tool to use in this study. The higher scores at pre-test left little room for change at post-test.

Conclusions

These results indicate educational programming is as effective as providing explicit and personalized physical fitness measurements. As such, a tailored educational campaign may be a cost-effective way to prevent cancer in an at-risk population or in a population that has had a personal experience with the disease. This study was a preliminary study and can be built upon for future research. In future studies, it would be wise to measure subjects' actual physical activity behavior outside of the lab (e.g. measure steps by pedometer) to see if Body Awareness or Educational Programming had an equal effect on participants' actual physical activity behavior. If it is true that subjects' behavior actually improves after an educational intervention, then millions could be targeted for a physical activity promotion campaign.

Tables

Table 1: BMI Weight Status for Adults

BMI	Weight Status
Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.9	Overweight
30.0 and Above	Obese

Table 2: Subject Descriptive Characteristics for All Subjects (n =100)

Descriptive Statistics for Combined BA and EA Groups					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	100	18.0	63.0	35.960	14.2055
Height	100	56.3	74.0	64.877	2.9353
Weight	100	93.90	269.00	153.4726	35.45999
BMI Score	100	17.7	46.0	25.572	5.8996

Table 3: Paired T-test Results. Change Scores within each BA and EA Group from Pre to Post-Test Questionnaire Scores.

Descriptive Statistics				
	Questionnaire Number	Mean Change Score	Standard Deviation	Significance
Educational Awareness	1	0.2	0.40406	0.001
	2	0.14	0.45221	0.033
	3	0.34	0.91718	0.012
	4	0.26	0.5646	0.002
	5	0.12	0.59385	0.159
	6	0.52	0.83885	0
	7	1.08	1.00691	0
	8	0.88	0.96129	0
	9	0.84	0.93372	0
Body Awareness	1	0.12	0.38545	0.032
	2	0.26	0.63278	0.005
	3	0.24	0.7709	0.032
	4	0.26	0.66425	0.008
	5	0.22	0.54548	0.006
	6	0.44	0.81215	0
	7	1.2	1.06904	0
	8	1.1	1.18235	0
	9	1.14	1.1954	0

Table 4: ANOVA Results. Mean Difference Scores between BA and EA Groups from Pre to Post-Test Questionnaire Scores.

Descriptive Statistics				
	Questionnaire Number	Mean Difference	Standard Error of Difference	Significance
Pre to Post Test Questionnaire Scores between BA and EA Groups	1	-0.0282	0.40305	0.622
	2	0.05657	0.5119	0.438
	3	-0.07071	0.74574	0.506
	4	0.05657	0.44813	0.376
	5	-0.01414	0.5247	0.85
	6	0	0.74231	1
	7	0.08485	1.16619	0.609
	8	0.12728	1.17534	0.448
	9	0.18385	1.15007	0.264

Appendix 1

Theory of Planned Behavior Questionnaire

Directions: The following questions address how you think and feel about ***exercising regularly for the next week***. Regular exercise is defined as: exercising at a ***moderate intensity or greater 3 or more times per week*** for at least ***30 minutes*** each time. Please ***circle*** the answer that best represents how you feel.

For me, regular ***exercise*** over the ***next week*** would be:

	Extremely Negative						Extremely Positive	
1. Useless	1	2	3	4	5	6	7	Useful
2. Unwise	1	2	3	4	5	6	7	Wise
3. Harmful	1	2	3	4	5	6	7	Beneficial
4. Unenjoyable	1	2	3	4	5	6	7	Enjoyable
5. Unpleasant	1	2	3	4	5	6	7	Pleasant
6. Boring	1	2	3	4	5	6	7	Exciting

7. How motivated are you to exercise regularly over the next week?

Not at all						Extremely Motivated
1	2	3	4	5	6	7

8. I plan to exercise regularly over the next week.

Strongly Disagree					Strongly Agree	
1	2	3	4	5	6	7

9. I intend to exercise regularly over the next week.

Strongly Disagree					Strongly Agree	
1	2	3	4	5	6	7

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